Journal of Biomedical Informatics 53 (2015) 174–179

Contents lists available at ScienceDirect

Journal of Biomedical Informatics

journal homepage: www.elsevier.com/locate/yjbin

The effects of organizational contextual factors on physicians' attitude toward adoption of Electronic Medical Records

Mohammadhiwa Abdekhoda [a], Maryam Ahmadi [a,b,*], Mahmodreza Gohari [c], Alireza Noruzi [d]

[a] Department of Health Information Management, School of Management and Medical Information Sciences, Iran University of Medical Sciences, Tehran, Iran
[b] Health Management and Economic Research Center, School of Management and Medical Information Sciences, Iran University of Medical Sciences, Tehran, Iran
[c] Department of Biomedical Statistic, School of Management and Medical Information Sciences, Iran University of Medical Sciences, Tehran, Iran
[d] Faculty of Library and Information Sciences, University of Tehran, Tehran, Iran

ARTICLE INFO

Article history:
Received 1 April 2014
Accepted 16 October 2014
Available online 25 October 2014

Keywords:
Electronic Medical Record
Physician
Technology Acceptance Model
Organizational contextual factors
Structural equation modeling

ABSTRACT

Introduction: Physicians' adoption seems to be a significant issue when comprehensive implementation of Electronic Medical Records (EMR) is considered. This study was conducted to determine the organizational contextual factors affecting physicians' adoption of EMR.
Methods: This was a descriptive-analytical study in which a sample of 330 physicians working in hospitals affiliated to Tehran University of Medical Sciences was selected. Physicians' attitudes toward EMRs' adoption have been assessed by a conceptual path model of Technology Acceptance model (TAM) and organizational context variables. Collected data were analyzed by $SPSS_{16}$ using regression analysis. The final model was tested by structural equation modeling (SEM) and represented by SPSS–AMOS, structural equation modeling software.
Results: The results suggest that modified proposed conceptual path model explains about 56% of the variance of EMRs' adoption. The findings also evidenced that perceived usefulness (PU), perceived ease of use (PEOU), management support; physicians' involvement, physicians' autonomy, and the doctor–patient relationship have direct and significant effect on physicians' attitudes toward EMRs' adoption. However, training showed to have no significant effect on PU and PEOU.
Conclusion: The present study acknowledged that considerable part of physicians' attitude toward EMRs' adoption is controlled by organizational contextual factors. These factors should be subsequently the major concern of health organizations and health policy makers.

1. Introduction

Adoption of Electronic Medical Records (EMRs) seems to be a significant issue when the comprehensive implementation of EMRs is taken into consideration [1–2]; accordingly, to have a thorough understanding of the advantages of EMRs, users' adoption of EMRs should be included in the investigation.

Although widespread of EMRs and its adoption by physicians and other health care providers are critical for the maintenance of patient care, the literature provides evidence for the failure of EMRs' implementation due to lack of users' adoption [1]. Recently, there has been a growing attempt to identify and predict human factors involved in the implementation process of technology. There are many organizational contextual factors affecting physicians' attitude toward EMRs' adoption which were examined in previous research studies [1,3–5]; however, the researchers have not found any study that identifies these factors in Iran.

In order to address these factors at the organizational, group, and individual levels, this study incorporated contextual factors into the Technology Acceptance Model (TAM), a model which is based on the assumption that a user's behavioral intention predicts actual use of the system. TAM is a prevalent theory of IT acceptance and is frequently used in health information technology (HIT) related studies conducted in clinical settings [6]. This model focuses exclusively on factors determining users' behavioral intentions, known as perceived usefulness (PU) and perceived ease of use (PEOU) toward using a new computer technology [7]. On the basis of the model presented in Fig. 1 H1–H9 were put forth and discussed in the following section.

* Corresponding author at: Department of Health Information Management, School of Management and Medical Information Sciences, Iran University of Medical Sciences, Tehran, Iran. Fax: +98 88772086.
E-mail address: Ahmadi.M@IUMS.ac.ir (M. Ahmadi).

http://dx.doi.org/10.1016/j.jbi.2014.10.008
1532-0464/

2. Hypotheses of the study

PU and PEOU, the two basic factors in TAM, have been found to control the end- users' intention to use specific information systems [8–10] as presented in H1 and H2:

H1. PU is positively associated with physicians' attitudes toward using and accepting EMRs.

H2. PEOU is positively associated with physicians' attitudes toward using and accepting EMRs.

Management support, *adequate training*, *physicians' involvement*, *physicians' autonomy* and the *doctor–patient relationship*; were the organizational contextual factors that have been analyzed in this study. These factors are commonly identified on the basis of literature review and prior empirical studies [1,3–5,11–12].

As lack of organizational leadership or executive commitment can be detrimental to the successful implementation of a new clinical information system [1], the following hypotheses, H3 and H4, have been put forth:

H3. Management support is positively associated with PU.

H4. Management support is positively associated with POEU.

In a user satisfaction study, Aaronson et al. [13] found that family practice residents' perception of training adequately were correlated with perceived usefulness [13]. Gadd and Penrod [14] surveyed physicians for six month after EHRs implementation and found that 23% of them did not believe they had received adequate training [14]. Therefore, hypotheses, H5 and H6, have been presented as follows:

H5. Adequate training is positively associated with PU.

H6. Adequate training is positively associated with PEOU.

Lorenzi and Riley [15] remarked that it was essential that physicians be treated as customers and that their needs be considered throughout the entire process of implementation [15]. Therefore, hypothesis H7 has been followed by this study:

H7. Physicians' involvement is positively associated with PEOU.

Implementation of EMRs involves substantial change, and a change of this magnitude may affect positions or power relations [15]. Consequently, when work roles, status and autonomy are adversely affected, resistance is likely to occur [1]. Hence, H8 has been put forth in this study:

H8. Physicians' autonomy is positively associated with PEOU.

Some studies have reported that physicians may perceive the use of a computer in the examination room as an obstacle, hindering workflow efficiency and disturbing patients [14,16–19]. Little research has been conducted in this area; however, doctor–patient relationship may be a determining factor on physicians' attitude toward EMRs' adoption. Thus, H9 has been put forth:

H9. Doctor–patient relationship is positively associated with PEOU.

The purpose of this study was to determine the organizational contextual factors that may affect physicians' acceptance of EMRs' adoption. Fig. 1 summarizes hypotheses and presents the proposed a conceptual path model of TAM and organizational contextual factors.

3. Methods

This study was conducted from August to October 2013 in teaching hospitals of Tehran University of Medical Sciences (TUMS). All hospitals were located in downtown of Tehran and were similar in the number of beds available, facilities and service delivery. A sample of 330 physicians was selected by stratified random sampling from a population of 919 physicians working in teaching hospitals affiliated to TUMS. TUMS was selected as the setting of this study for two reasons: it was the first rank medical university in Iran and a considerable intention for adoption of recent technologies was pursued in this university.

A researcher-made questionnaire on the basis of Wilkins', Nair's, Morton's and Conrad's questionnaires was developed for data collection [1,9,20–21]. Eight faculty members of health information management department in TUMS confirmed the content and face validity of the survey instrument. Test–retest was used to measure the reliability (91.2). The questionnaire consisted of 30 structured questions/items on PU, PEOU, *management support, adequate training, physicians' involvement*, *physicians' autonomy*, and *doctor–patient relationship*. The questionnaire was rated on a 5-Likert scale ranging from "5 = totally agree," "4 = agree," "3 = neutral" "2 = disagree," and "1 = totally disagree". There were also four demographic questions about participants' age, sex, level of education and job experience.

The survey was performed by using TUMS webmail services and an introductory e-mail explaining the purpose of the study was sent to the participants. From 330 questionnaires, 278 of them were returned, but at the end, 237 questionnaires were appropriate for analysis. From 41 inappropriate questionnaires, 9 questionnaires were incomplete and 32 of them were incorrectly filled out. To recognize the correlation between variables and to simplify the model

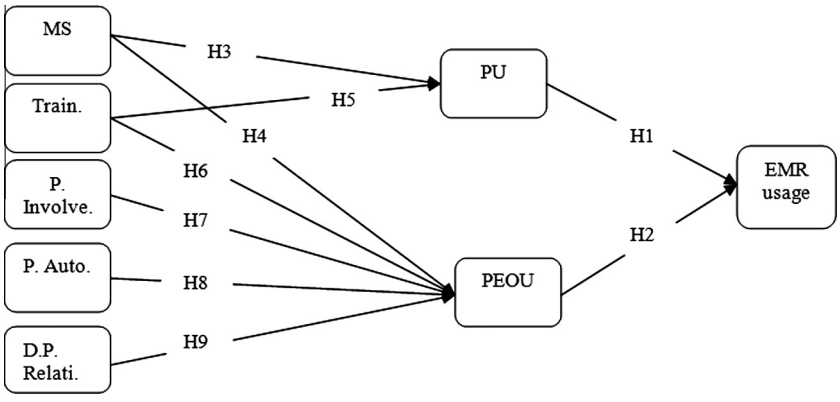

Fig. 1. Hypotheses and the proposed conceptual path model of TAM and organizational context variables.

prior to testing, a correlation matrix was constructed. Moreover, a graphical path model was expanded to validate the proposed research model. The collected data were analyzed by $SPSS_{16}$ software. The correlation between variables was measured by Pearson's correlation and regression tests. Structural equation modeling (SEM) was used to analyze predicted paths between the variables of the model. The proposed conceptual path model (Fig. 1) was developed by $AMOS_{16.0}$ using SEM. Finally, the modified model was presented. Table 1 shows the questions used in the survey measuring the various constructs in the model.

4. Results

Demographic information of the study participants (Table 2) shows the majority of the participations (54%) were female. The mean age of the respondents was 32, and 35.9% of the participants were in the age range of 31–35. About 43% of the participants were general practitioners. The data also showed the mean year of 6.07 for the physicians' work experience while less than half of them (43%) had 1–5 years of work experience.

According to the findings, shown in Table 3, there was a positive and significant correlation between TAM variables i.e. PU, PEOU and EMRs' usage. This table also shows a positive and significant correlation between *management support* and PU, PEOU and EMRs' Usage. It was also found that *training* had no significant correlation with EMRs' usage, PU and PEOU. Moreover, *Physicians' involvement* appeared to have a positive and significant correlation with EMRs' usage, PU and PEOU. As it is shown in this Table, there was a significant and positive correlation between *physicians' autonomy* and EMRs' usage, PU and PEOU. Furthermore, the positive and significant correlation between *doctor–patient relationship* with EMRs' usage, PU and PEOU are displayed in this table.

Fig. 2 presents the authorization of the proposed conceptual path model. On the basis of this Figure, PU and PEOU appeared to have positive and significant effects on using and adoption of EMRs. Also this Figure shows *management support* had a positive and significant effect on both PU and PEOU whereas there was no significant effect of *adequate training* on TAM variables. This figure also shows that *physicians' involvement*, *physicians' autonomy* and *doctor–patient relationship* had positive and significant effects on PEOU. Furthermore, this Figure displays that the model explains about 56% of the EMRs' using variance ($R^2 = 0.56$). *Management support* explains about 52% of PU variance ($R^2 = 0.52$). Also, *management support*, *physicians' involvement*, *physicians' autonomy* and *doctor–patient relationship*, together, explain about 49% of PEOU variance ($R^2 = 0.49$).

Recommended goodness-of-fit measure is summarized in Table 4 showing that a relative X^2 value of 1.9 was obtained which is acceptable. Tucker–Lewis index (TLI), comparative fit indices (CFI), Normal fit index (NFI) and Root Mean Squared Error of Approximation (RMSEA) were considered and appeared to be favorable.

5. Discussion

The results of this study supported the significant effect of organizational contextual factors on physicians' attitude toward EMRs' adoption. Accordingly, this issue should be considered when the successful implementation and adoption of EMRs is pursued by healthcare organizations.

Demographic information showed that about 20% of the participants did not indicate gender; however, it was already known that the proportion of females to males was twice. Only about 5% of the sample was in the age range of 41–45, and 43% of participants had

Table 1
Items used to measure the various constructs in the model.

Construct	Item number	Items
Perceived usefulness	1	Using EMRs in my job would enable me to do tasks more quickly
	2	Using EMRs improve my job performance
	3	Using EMRs would make it easier to perform my job
	4	Apply EMRs are helpful in my job
Perceived ease of Use	5	I think that interaction with EMRs would be clear and understandable
	6	I believe navigation of EMRs would be easy
	7	Learning to operate EMRs would be easy for me
	8	It would be easy for me to become skillful at using EMRs
Using and accepting EMRs	9	I use EMRs in my work routinely
	10	I would like use EMRs in my work in future
	11	Many of routinely work was carried out by using EMRs in my job
Management support	12	The EMR project is important to top management
	13	The EMR project will be introduced to me effectively by the management
	14	Management will do a helpful job during the implementation of the EMR
	15	Management expects me to use the EMR
Adequate training	16	I will receive the training that I need to be able to understand and use the EMR
	17	The EMR training will make it more useful to me
	18	The EMR training will make it easier for me to use this technology
Physicians' involvement	19	My involvement during the EMR implementation phase will be effective
	20	My involvement during the EMR implementation phase will make the EMR more useful to me
	21	My involvement during EMR implementation phase is must
	22	My involvement during the EMR implementation phase will positively affect my attitude about using EMR
Physicians' autonomy	23	Using the EMR increase the hospital administration's ability of control and monitor physicians clinical practices and decision-making
	24	Using the EMR may threaten the physicians' personal and professional privacy
	25	Using the EMR may result in legal or ethical problem for the physician
	26	Using the EMR may limit the physicians' autonomy in making clinical decisions or judgments
Doctor–patient relationship	27	Using the EMR will likely threaten the physician's credibility with his/her patients
	28	Using the EMR will likely reduce the patient's satisfaction with the quality of health care he/she receives
	29	Using the EMR will likely interfere with the effectiveness of the doctor–patient interaction
	30	The patient's confidence in the physician will likely be diminished if the patient see the physicians using the EMR

Table 2
Demographic information of the sample.

Demographics	Category	Freq.	Per.	Mean	S.D
Gender	Male	66	27.8		
	Female	130	54.9		
	Total	196	82.7		
Age	25–30	62	26.3	31.8	2.09
	31–35	85	35.9		
	36–40	46	19.42		
	40–45	9	3.8		
	45⩽	1	0.4		
	Total	203	85.6		
Degree	General practitioner	102	43		
	Specialists	129	54.4		
	Fellowship	3	1.3		
	Total	234	98.7		
Work experience	1–5	102	43	6.07	3.1
	5–10	32	13.5		
	10⩽	16	6.8		
	Total	150	63		

Table 3
Correlation between variables of proposed conceptual path model.[a,b]

Constructs	Usage	PEOU	PU	MS	Train.	P. Involv.	P. Auto.	D.P. Relati.
Usage	1							
PEOU	0.614**	1						
PU	0.562**	0.624**	1					
MS	0.592**	0.698**	0.706**	1				
Train	0.122	0.039	0.028	0.053	1			
P. Involv.	0.447**	0. 44**	0.430**	0.542**	0.250**	1		
P. Auto.	0.225**	0.238**	0.144*	0.143*	0.186**	0.200**	1	
D.P. Relati.	0.314**	0.356**	0.250**	0.359**	0.177**	0.420**	0.300**	1

PEOU: perceived ease of use; PU: perceived usefulness; MS: management support; Train: adequate training; P. Involv: physicians' involvement; P. Auto.: physicians' autonomy; D.P. Relati.: doctor–patient relationship.

[a] (∗) *P*-value is significant at 0.05 levels.

[b] (∗∗) *P*-value is significant at 0.01 levels.

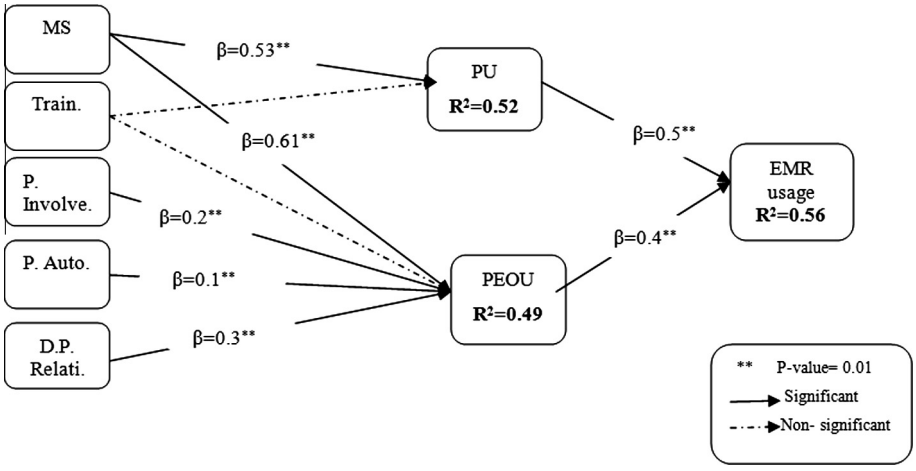

Fig. 2. Authorizing proposed conceptual path model' results.

Table 4
Recommended goodness-of-fit measure.

Fit index category	Suggested index	Suggested value	Obtained value
Absolute fit	Relative X^2	Relative X^2 < 3.0	1.9
Incremental fit	Tucker–Lewis Index (TLI)	.90 or above acceptable fit	.92
Incremental fit	Comparative fit index (CFI)	.90 or above	.95
Incremental fit	Normal fit index (NFI)	.90 or above	.93
Parsimonious fit	Root Mean Squared Error of Approximation (RMSEA)	⩽0.1	.02

1–5 years of work experience (Table 2). As the study was performed in teaching hospitals, where usually newly employed physicians and residents work, the data derived in age range and work experience was predictable.

Regarding the standard coefficient of PU and EMRs' adoption ($\beta = 0.5$, $p = 0.01$), indicating the association between PU and EMRs adoption, H1 was supported. Furthermore, it was found that PEOU positively affected EMRs' adoption ($\beta = 0.4$ with $p = 0.01$), which supports H2. These findings are similar to the results of the studies carried out by Kowitlawalkul [4], Zhang et al. [22], Holdan and Karsh [23], Pai and Huang [24], and Abdekhoda et al. [8], reporting that PU and PEOU have positive and significant effect on information systems use and acceptance [4,8,22–24].

Concerning the association between *management support* and PU, the results showed that *management support* had positive and significant effect on PU ($\beta = 0.53$, $P = 0.01$); hence, H3 was supported. Also, the findings revealed positive and significant correlation between *management support* and PEOU, supporting H4 and showing that *management support* is positively associated with PEOU. This finding is in line with the findings of Morton [1], Kowitlawakul [4], and Wu et al. [5] reporting that there is positive and significant path coefficient rates between *management support* and TAM variables, PU and PEOU [1,3–5].

Concerning the relationship between *adequate training*, PU and PEOU, unexpectedly, the findings showed there was no significant relationship between *adequate training* PU and PEOU (Fig. 2). Thus H4 and H5 were not supported in this study. Similarly, Morton [1] found that there was no significant correlation between *training* and TAM variables and concluded that *training* had no significant effect on PU and PEOU [1]. However, Aggelidis and Chatzoglou [11] and Moeinedin [12] found that *training* had positive and significant effect on PU and PEOU which should be considered as main parts of organizational contextual factors when successful implementation of information systems is considered [11,12].

As for the relationship between *physicians' involvement* and PEOU, the findings were favorable ($\beta = 0.2$, $p = 0.01$) and supported H7. Likewise, Kowitlawakul [4] found that *physicians' involvement* had positive and significant effect on PEOU [4], whereas Morton [1] reported that there was no significant correlation between *physicians' involvement* and PEOU [1].

As it is shown in Fig. 2, there was a positive and significant relationship between *physicians' autonomy* and PEOU ($\beta = 0.1$, $P = 0.01$), supporting H8 and suggesting that *physicians' autonomy* is positively associated with PEOU. This finding supports the findings of the studies conducted by Aldosari [3] and Moeinedin [12], and is in contrast with Morton [1] who found no significant relationship between *physicians' autonomy* and PEOU [1].

Finally, there was a positive correlation between the *doctor–patient relationship* and PEOU, ($\beta = 0.3$, $P = 0.01$) supporting H9 and showing that *doctor–patient relationship* was positively associated with PEOU. Similarly, Moeinedin [12] reported that *doctor–patient relationship* had positive and significant effect on PEOU [12]. But Morton [1] found that *doctor–patient relationship* had negative and significant effect on PEOU [1].

Furthermore, as displayed in Fig. 2, the model explains about 56% of the EMRs' using variance ($R^2 = 0.56$). This finding is favorable and comparable with what is reported in general TAM (30–40%) and heath care TAM (55%) literature [8,25].

Overall, the contributions of this study to the research on EMRs' adoption are fivefold. First, the results of this study showed that *management support* had positive and significant effect both on PU and PEOU. Second, surprisingly, *training* had no significant effect on PU and PEOU. Third, the positive and significant coefficient reported from *physicians' involvement* to PEOU, shows *physicians' involvement* was positively associated with PEOU. Next, this study showed that *physicians' autonomy* had positive and significant effect on PEOU. Finally, the result of this study revealed that PEOU of EMRs' adoption was controlled by the *doctor–patient relationship*. Moreover, the present study attempted to propose some modifications for accepting and adopting EMRs by physicians in Iran and other settings.

Self-reported use of EMRs instead of measuring the actual use of it, self-selection biases of the items in the questionnaire, limiting the setting of this study to teaching hospitals in downtown of Tehran, are some of the limitations which need to be addressed in future studies.

6. Conclusion

This is the first study conducted to examine the effect of organizational contextual factors on physicians' attitude toward EMRs' adoption, in Iran. The findings of this study make significant contribution both to theory and practice of EMRs' adoption. The results from SEM analysis revealed that organizational contextual factors are the main determinants in leading physicians' attitude toward EMRs adoption. The study clearly identified six relevant factors affecting physicians' attitudes toward EMRs adoption: *perceived ease of use*, *perceived usefulness*, *management support*, *physicians' involvement*, *physicians' autonomy* and *doctor-patient relationship*. Much research also remains to be done on improving the proposed model and identifying other factors such as security factors and physicians' personality characteristics. Probing factors affecting other clinical staff such as nurses' and pharmacists' attitude toward EMRs' adoption is also suggested.

References

[1] Morton ME. Use and acceptance of an electronic health record: factors affecting physician attitudes [Retrieved From Proquest Dissertations and Theses Database. (Umi No. 3327272)]: Drexel University; 2008.
[2] Ash JS, Bates DW. Factors and forces affecting EHR system adoption: report of a 2004 ACMI discussion. J Am Med Inform Assoc 2005;12(1):8–12.
[3] Bakhet A. Factors affecting physician attitudes about the medical information system usage and accepting through the mandate implementation of integrated medical information system at the Saudi Arabia national Guard health system: a modified technology acceptance model. Pittsburgh; 2003.
[4] Kowitlawakul Y. Technology acceptance model: predicting nurses' acceptance of telemedicine technology (eICU®); 2008.
[5] Wu JH, Shen WS, Lin LM, Greenes RA, Bates DW. Testing the technology acceptance model for evaluating healthcare professionals' intention to use an adverse event reporting system. Int J Qual Health Care 2008;20(2):123–9.
[6] Melas CD, Zampetakis LA, Dimopoulou A, Moustakis V. Modeling the acceptance of clinical information systems among hospital medical staff: an extended TAM model. J Biomed Inform 2011;44(4):553–64.
[7] Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. Mis Quart 1989:320.
[8] Abdekhoda M, Ahmadi M, Dehnad A, Hossini F. Information technology acceptance in health information management. Methods Inf Med 2013;53(1).
[9] Conrad ED. Willingness to use IT innovations: a hybrid approach employing diffusion of innovations and technology acceptance models. Southern Illinois University Carbondale; 2009.
[10] Duyck PPB, Devolder P, Voet T, Adang L, Vercruysse J. User acceptance of a picture archiving and communication system–applying the unified theory of acceptance and use of technology in a radiological setting. Methods Inf Med 2008;47(2):149–56.
[11] Aggelidis VP, Chatzoglou PD. Using a modified technology acceptance model in hospitals. Int J Med Informatics 2009;78(2):115–26.
[12] Moeinedin FM. Assessing primary care physicians' attitudes towards adoption of an electronic tool to support cancer diagnosis. University of Toronto; 2011.
[13] Aaronson JW, Murphy-Cullen CL, Chop WM, Frey RD. Electronic medical records: the family practice resident perspective. Fam Med – Kansas City 2001;33(2):128–32.
[14] Gadd CS, Penrod LE, editors. Dichotomy between physicians' and patients' attitudes regarding EMR use during outpatient encounters. In: Proceedings of the AMIA symposium. American Medical Informatics Association; 2000.
[15] Lorenzi NM, Riley RT. Managing change: an overview. J Am Med Inform Assoc 2000;7:116–24.
[16] Hsu J, Huang J, Fung V, Robertson N, Jimison H, Frankel R. Health information technology and physician-patient interactions: impact of computers on communication during outpatient primary care visits. J Am Med Inform Assoc 2005;12(4):474–80.

[17] Wager KA, Lee FW, Glaser JP. Managing health care information systems: a practical approach for health care executives. Jossey-Bass; 2005.
[18] Huber J. Patient acceptance of computerized progress note documentation. Information technology for the practicing physician. Springer; 2001. p. 114–7.
[19] Anderson JG. Clearing the way for physicians' use of clinical information systems. Commun ACM 1997;40(8):83–90.
[20] Wilkins MAJ. The health information manager as change agent in adopting electronic health record technology in hospitals. Capella University; 2009.
[21] Nair SV. Benefits and security of electronic health record (EHR) use by pediatric staff: A technology acceptance model (TAM)-based quantitative study: Doctor of Philosophy thesis. Capella University; 2011.
[22] Zhang N, Guo X, Chen G. IDT-TAM integrated model for IT adoption. Tsinghua Sci. Technol. 2008;13(3):306–11.
[23] Holden RJ, Karsh BT. The technology acceptance model: its past and its future in health care. J Biomed Inform 2010;43(1):159–72.
[24] Pai FY, Huang KI. Applying the technology acceptance model to the introduction of healthcare information systems. Technol Forecast Soc Chang 2011;78(4):650–60.
[25] Holden RJ, Brown RL, Scanlon MC, Karsh B-T. Modeling nurses' acceptance of bar coded medication administration technology at a pediatric hospital. J Am Med Inform Assoc 2012;19(6):1050–8.